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Business Cooperative Research Centres Programme

Two Case Studies from Tranche 1

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Capitalised Amenity Value of Urban Stream Rehabilitation

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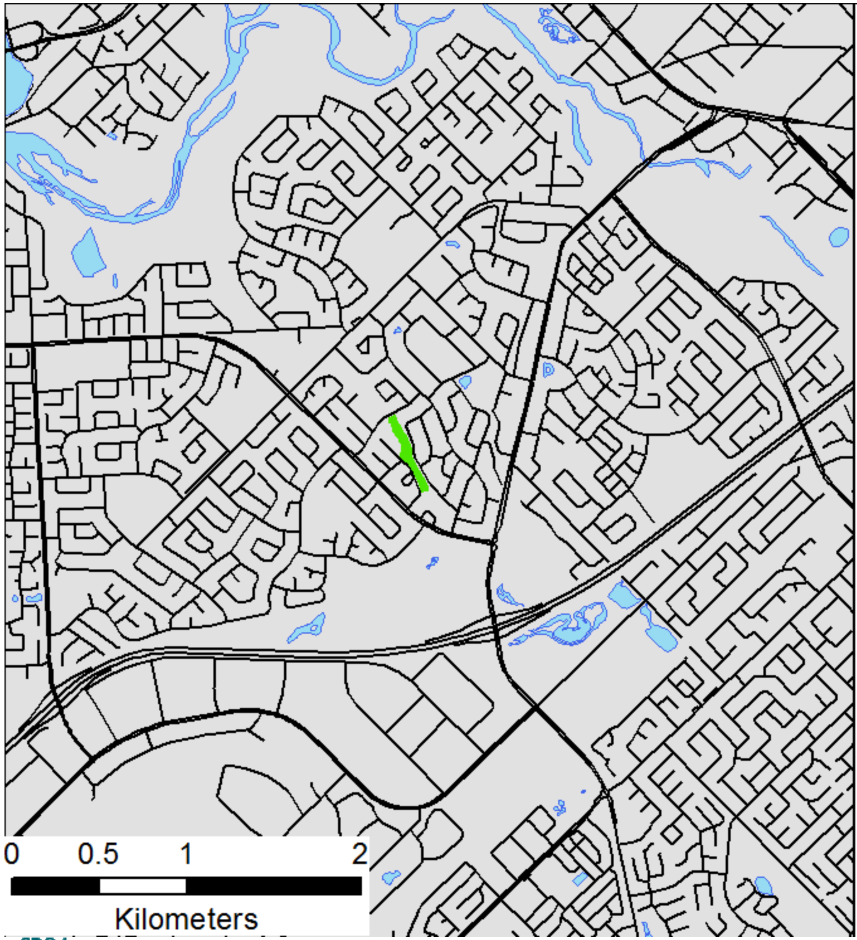
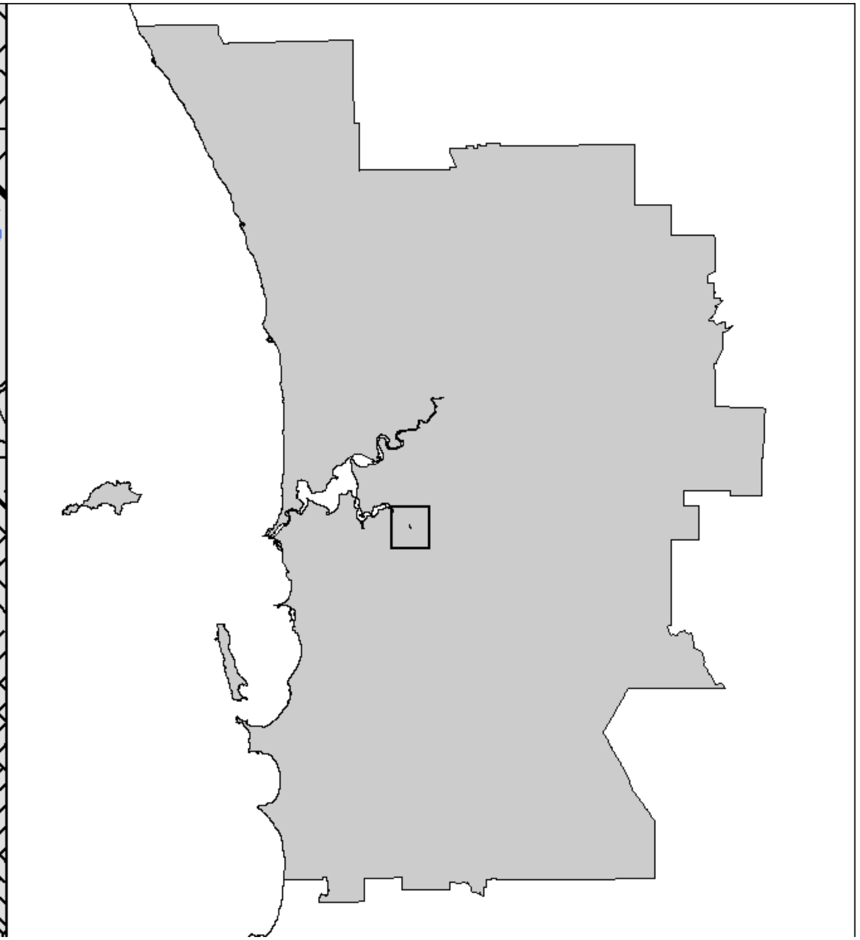
Urban drain vs Living stream

- Traditional drain
  - Drainage
- Living stream
  - Drainage
  - Remove nutrients
  - Support biodiversity
  - Social value
- More information about living streams

Case study:
Bannister Creek Living Stream Project

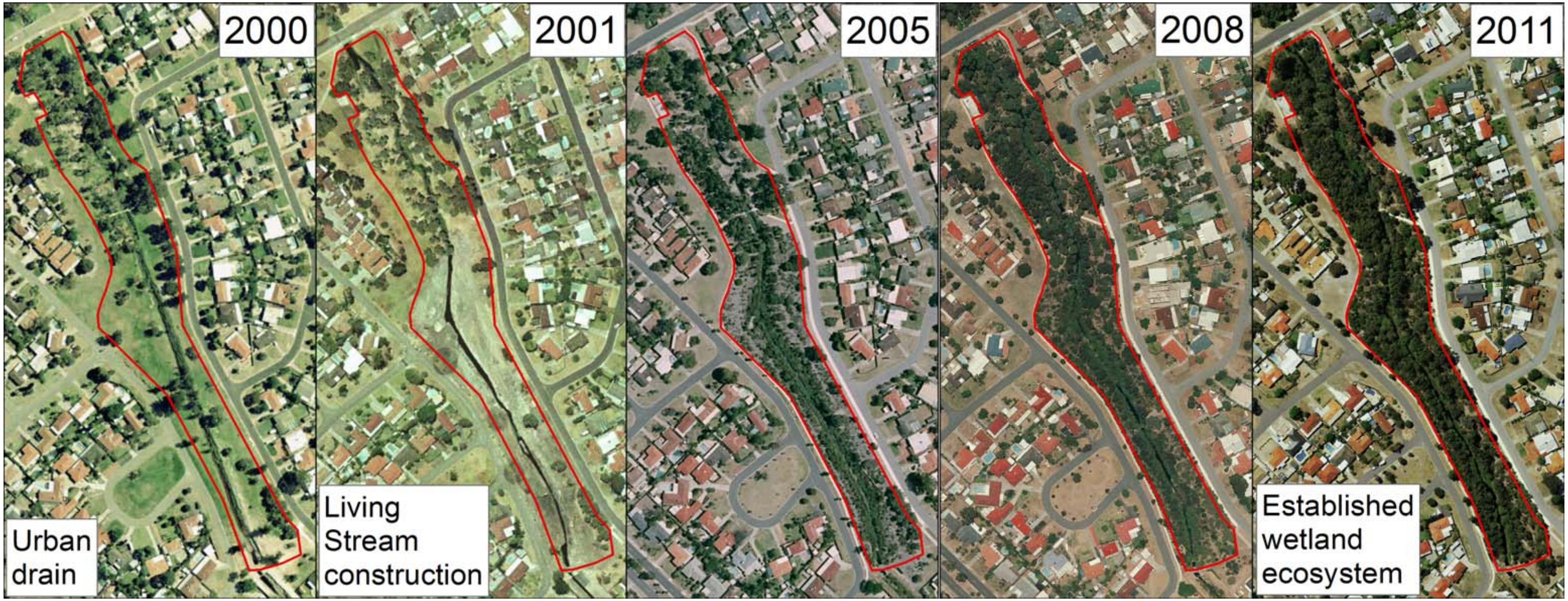




Case study:
Bannister Creek Living Stream Project

- Implemented by the Bannister Creek Catchment Group and the City of Canning from the late 2000
- Give the creek a more natural shape with meanders, riffles, fringing sedges, gentle sloping banks and thick vegetation on the banks
- More information - SERCUL pamphlet

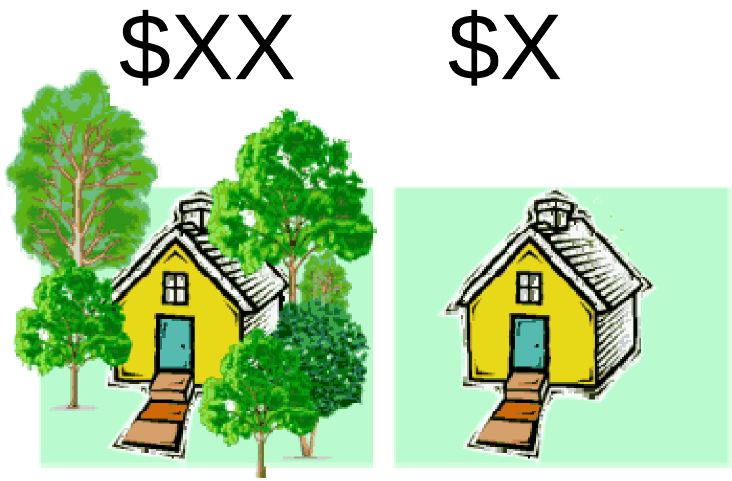
Bannister Creek Living Stream Project 2000-2011



Measuring Non-Market Values

- Stated preference methods
  - Ask people how do they value things

- Revealed preference methods
  - Observe how do people behave (how much do they pay for things)
  - Watch video about valuation using hedonic pricing method



Estimating Amenity Value: Hedonic Model

$$Log(P_{it}) = \alpha_1 LS_{it} + \alpha_2 LSY_{it} + \mathbf{\beta X}_{it} + \boldsymbol{\gamma}_t + \boldsymbol{\rho}_j + \varepsilon_{it} + \boldsymbol{\eta}_i$$

Time fixed effects (year-quarter)

Spatial fixed effects (SA1)

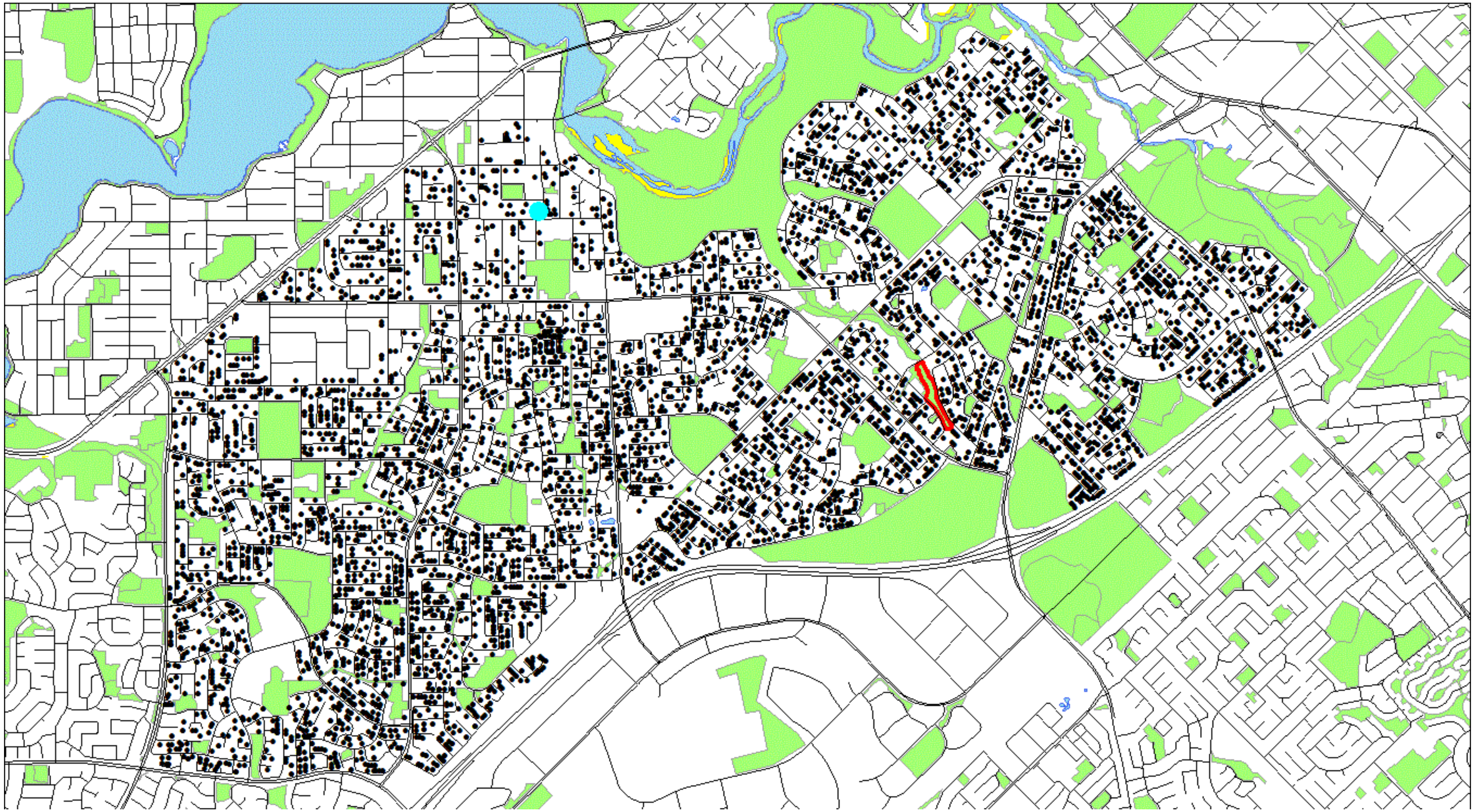
Living stream

Years since Living stream

Characteristics of a house

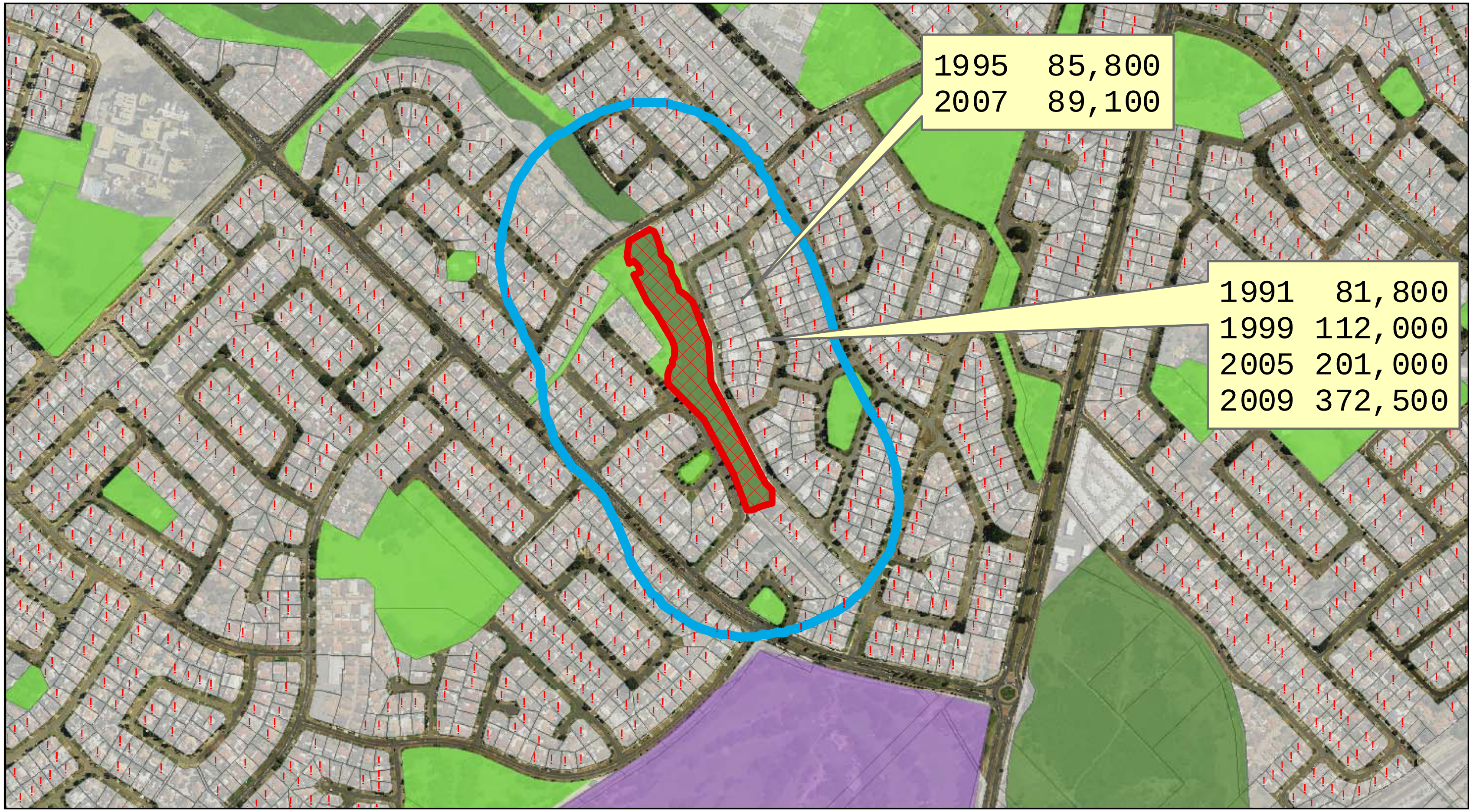
$$Log(P_{it}) = \alpha_1 LS1_{it} + \alpha_2 LS2_{it} + \alpha_3 LS3_{it} + \alpha_4 LS4_{it} + \mathbf{\beta X}_{it} + \boldsymbol{\gamma}_t + \boldsymbol{\rho}_j + \varepsilon_{it} + \boldsymbol{\eta}_i$$

Sales Data

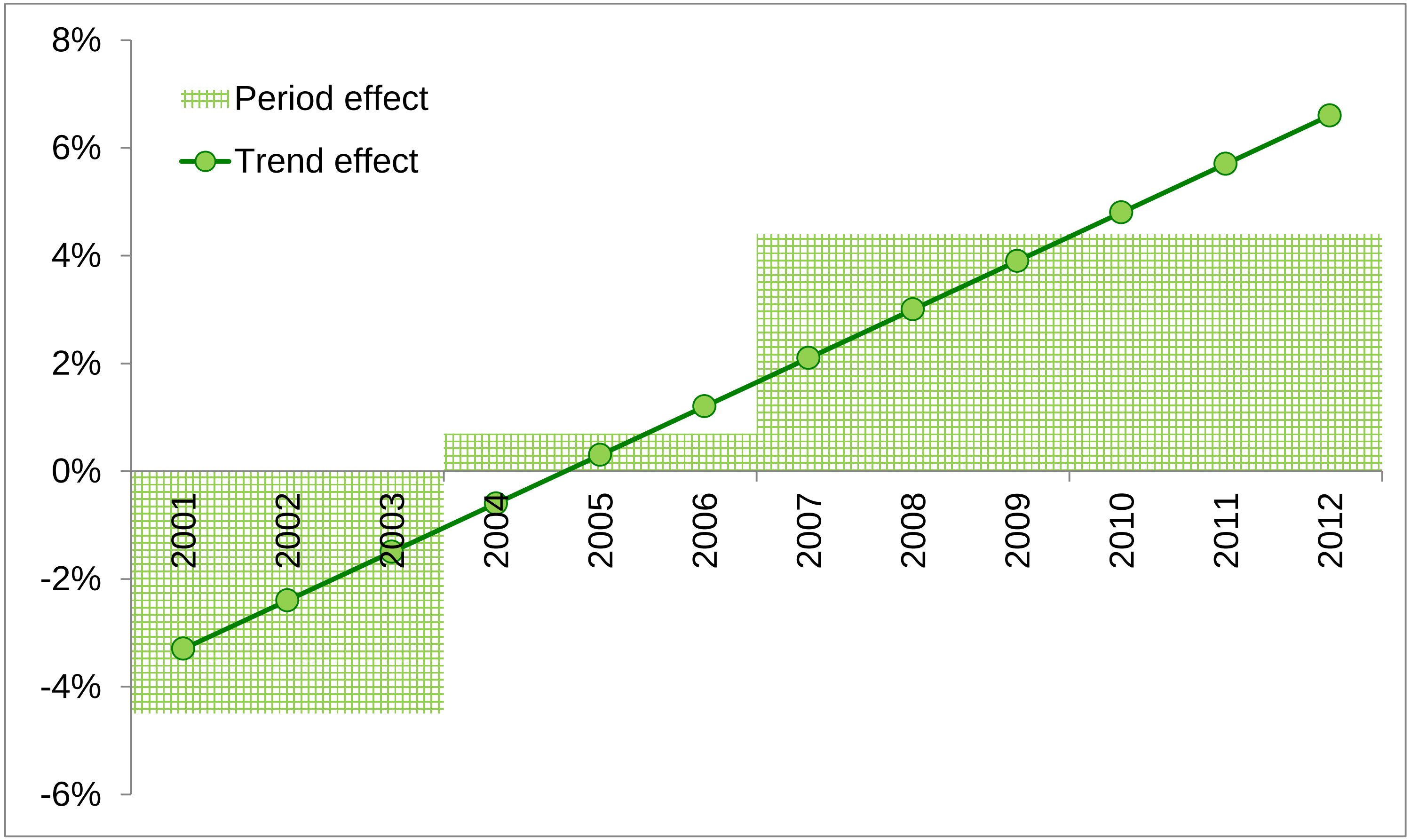


Suburbs:
Lynwood,
Langford,
Ferndale,
Parkwood,
Riverton,
Willeton

Sales Data


1995 85,800
2007 89,100
1991 81,800
1999 112,000
2005 201,000
2009 372,500

Impact of Bannister Creek Living Stream on house values within 200 m



Cost-benefit analysis

- Benefits in 2010: $404K * 4.4% * 270 = $4.8M
- Costs (compounded to 2010 @ 7%): $1.9M
- Benefit-Cost ratio: 2.5

- Sensitivity analysis:

Benefit estimate	Costs discount rate		
	5%	7%	9%
Low (2.9%)	1.8	1.6	1.5
Central (4.4%)	2.6	2.5	2.2
High (6.0%)	3.5	3.3	3.0

Conclusions

- In Western Australia, proponents of WSUD have had limited success in promoting their ideas

- Possible reason is lack of *ex post* evaluations

- Our evaluation of a specific WSUD project have shown project benefits to be larger than costs

More information

- https://watersensitivecities.org.au/content/new-publication-value-restoring-urban-drains-living-streams/
- https://watersensitivecities.org.au/content/the-value-of-restoring-urban-drains-to-living-streams/

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ELSEVIER

The value of restoring urban drains to living streams

CrossMark

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Optimal Actions to Reduce Nutrient Emissions in the Canning Catchment

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Outline

- ❑ Aim
- ❑ Values
- ❑ Conceptual framework
- ❑ Modelling approach
- ❑ Results
- ❑ Conclusions

Aim of the project

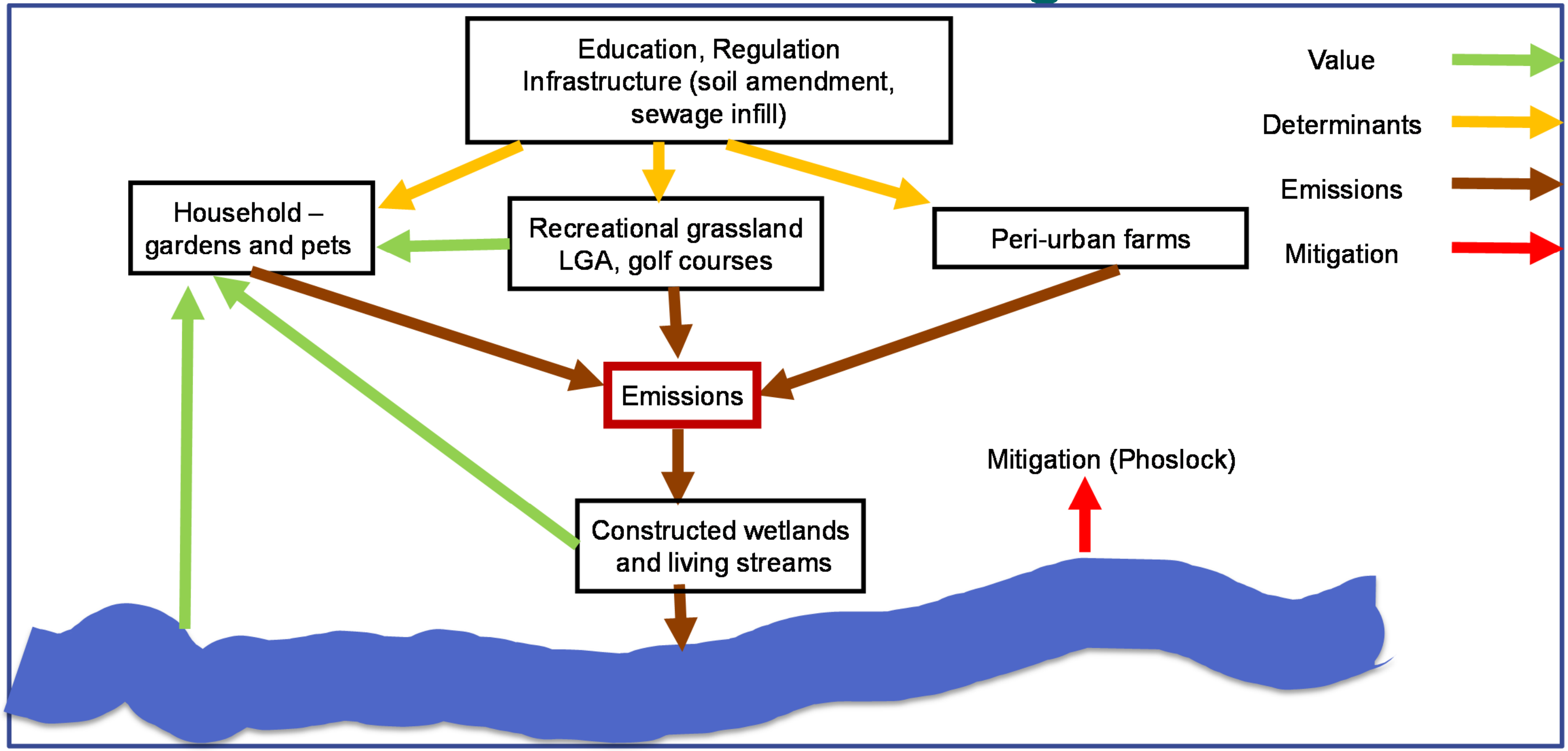
Determine a cost-effective action to reduce nitrogen and phosphorous emissions to the Canning River

- Optimal mix or abatement actions
- Trade-off between alternative actions
- Feasibility of achieving abatement targets
- Cost of achieving target

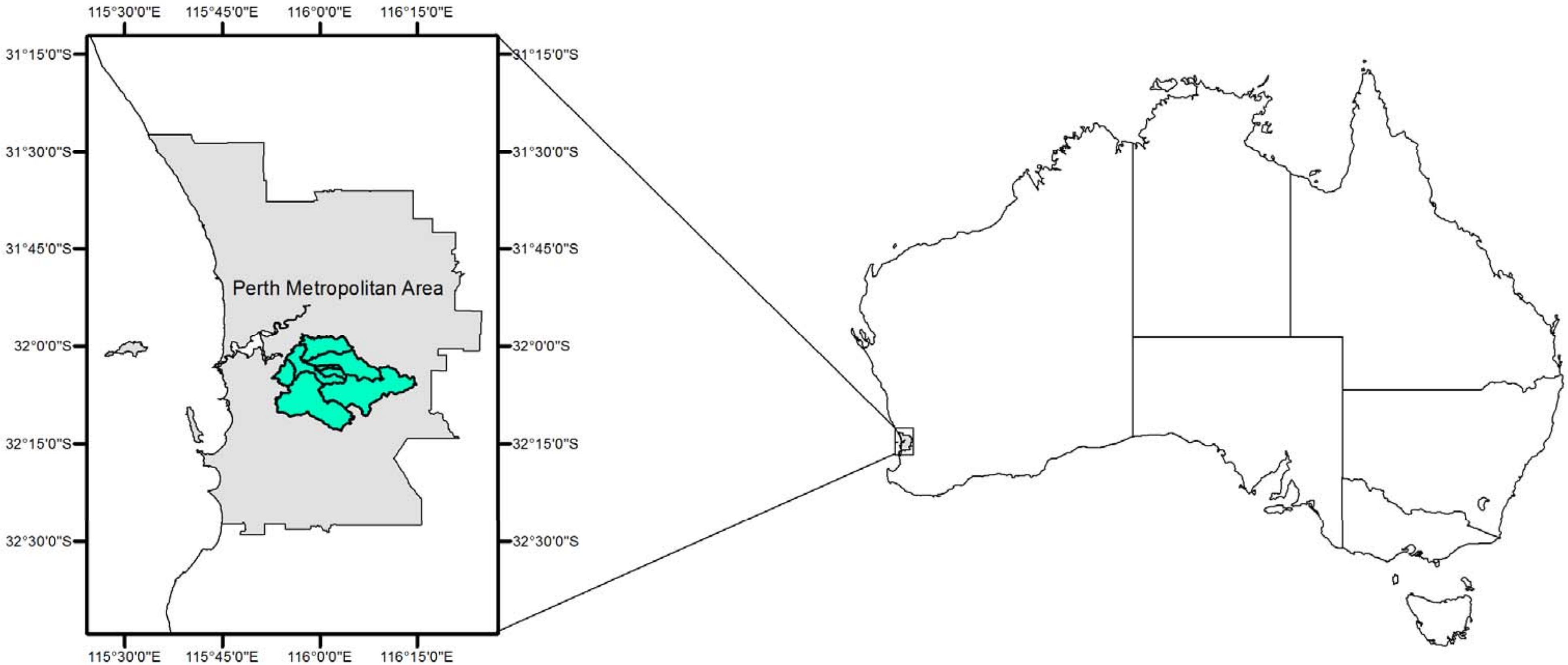
Values: why are they important?

- Setting a water quality target implies a value on the resource, in this case the value of water quality in the Canning.
- In 2012 a study commissioned by the Swan River Trust found that respondents from WA highly valued reducing fish kills, improving dolphin health and increasing the extent of river banks vegetation in the Swan-Canning
- Of particular relevance to this study is the estimate that the annual value of reducing fish kills from an average of 2 per year to 1 per year had a value of between $34 million and $59 million per year to WA residents.
- This analysis was repeated for the residents of the Canning catchment and their estimate WTP was $22 million per annum.
- This can be interpreted as a valuation of reduce nutrient emissions in the Canning to target levels.

Overview of Emissions and Mitigations



Study area



115°30'0"E
115°45'0"E
116°0'0"E
116°15'0"E
31°15'0"S
31°30'0"S
31°45'0"S
32°0'0"S
32°15'0"S
32°30'0"S
Perth Metropolitan Area

Modelling Approach

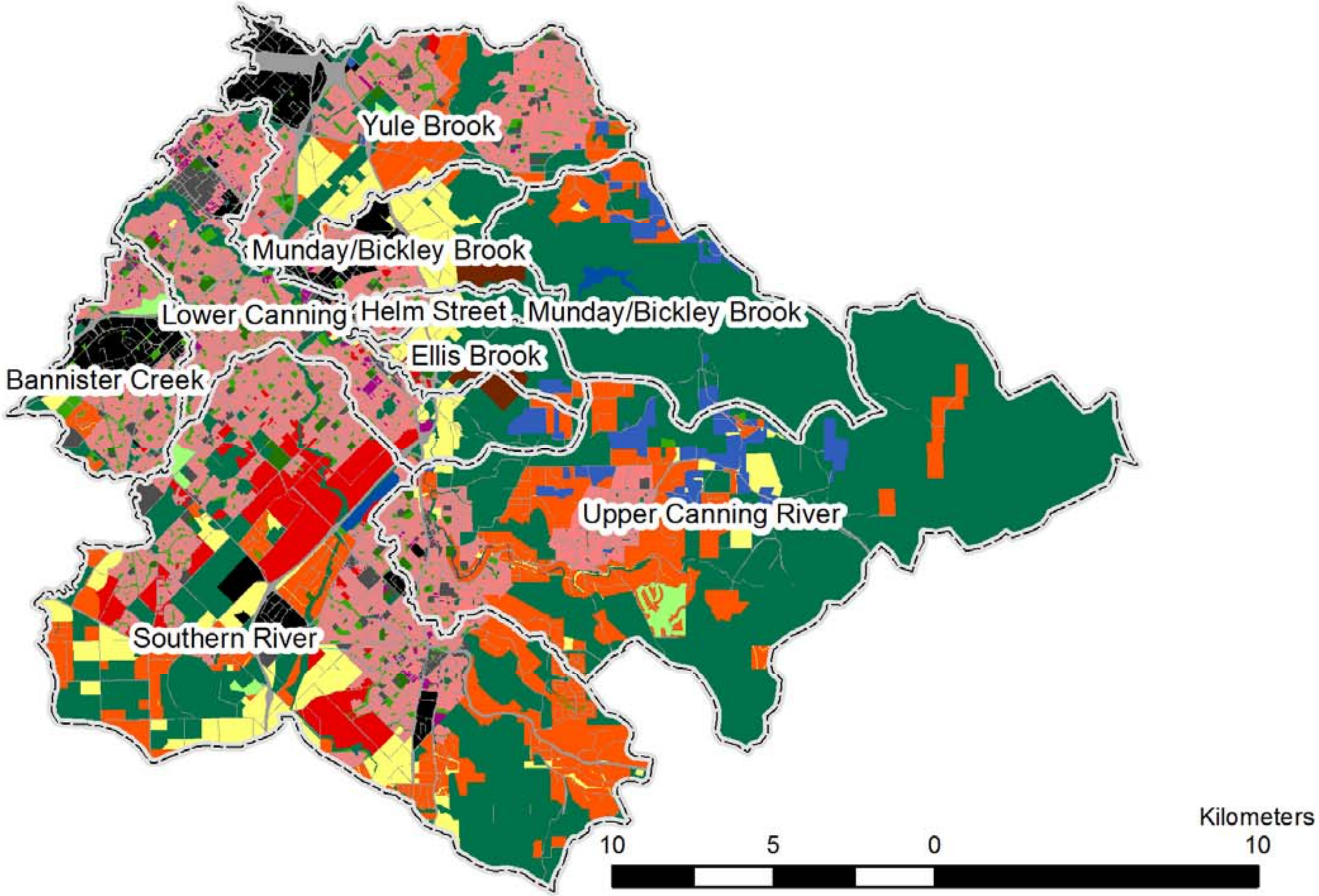
- Minimize present value of costs of achieving average annual emission targets
- By applying nutrient emission abatement actions across catchments and time
- Modelling unit: land use within a sub-catchment

Data

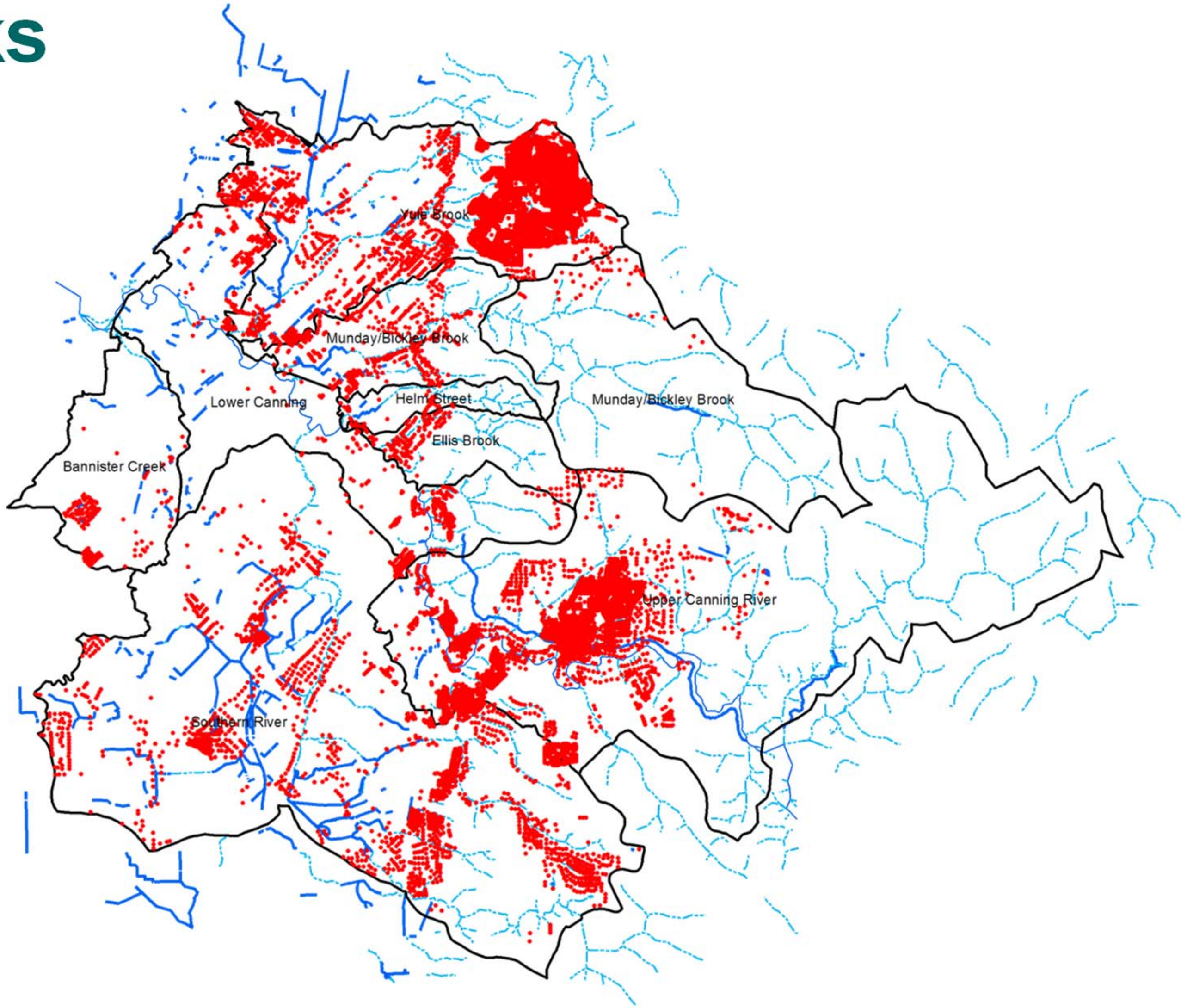
Element of the model	Land use	Nutrient inputs	Transmission	Waterways
Data sources	Zoning maps Cadastre Aerial photos	UNDO Kelsey et al 2010	Joel Hall @ DOW Kelsey et al 2010	
Abatement		Infill septic tanks Behaviour change Slow release fertilisers Fertiliser action plan Ban regular fertilisers	Constructed wetlands Imported fill on developments	PhosLock
Data sources		Sergey Volotovskiy @ watercorp Ashton-Graham 2013 Kelsey et al 2010 Shuman 2003	Kelsey et al 2010 Mark Cugley @ DPAW	Mark Cugley Jennifer Stritzke @ DPAW

Land uses

area__ha	Land uses
21062	bush
961	commercial
1787	development
23	drain
357	golf course
1142	horticulture
1907	industrial
461	mining
1036	park
6245	rural residential
2978	rural
317	sport
5323	transportation
7322	urban residential
	urban residential unitts
	water



Septic tanks



Emission abatement actions

- Infill of septic tanks ($20K, $30K, $50K, and $80K)
- Constructed wetlands
  - Cost: construction ($1.9 M/ha); maintenance 1% of construction cost
  - Remove N and P, different by catchment
- Imported fill (Iron man gypsum) for new developments
  - Cost $25K/ha
- Behaviour change to reduce garden fertilizer use (Urban Residential)
  - Intensive: $475/hh, participation 25%, reduction 50%, decline in 10 years
  - By phone: $50/hh, participation 5%, reduction 50%, decline in 10 years
- Fertiliser action plan (Agricultural land use)
  - Cost $30/ha/y, reduces P by 30%
- Slow release fertilisers (Public Open Space)
  - Cost $200/ha/y, reduces N by 20%
- Phoslock (Waterways)
  - Cost $340 per kg P removed

Other Modelling Assumptions

- 20 years time frame
- First decade "development" land use becomes urban residential (increasing emission)
- Emissions and abatement actions of last decade repeats in perpetuity
- Present value at 5%

Photo Credit: Jazmin Lindley

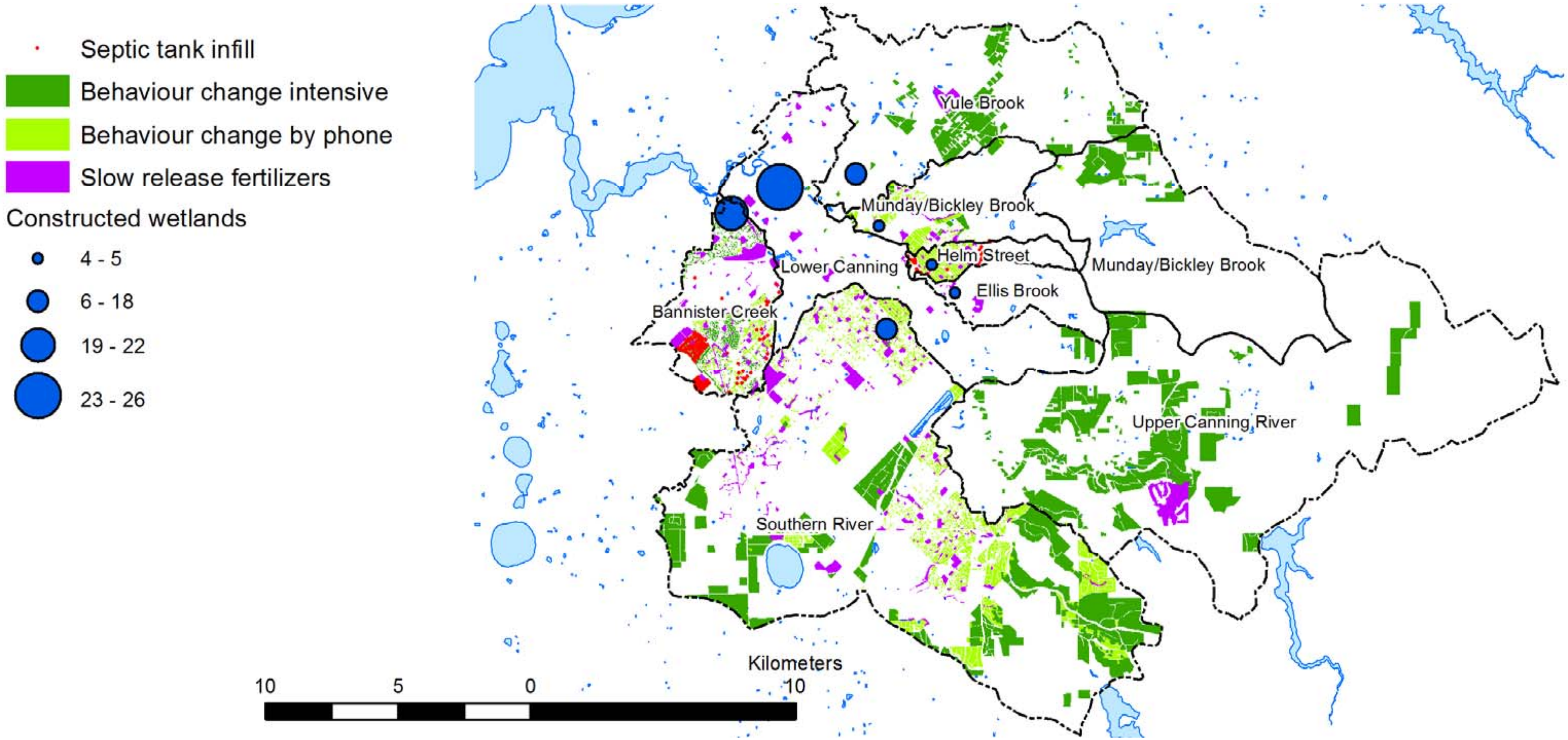
Abatement targets

	N export, ton/year	P export, ton/year
Current emission (our modelling)	58.1	4.5
20% of target	53.3	4.2
40%	48.6	3.9
60%	43.9	3.7
80%	39.1	3.4
Target (Maximum acceptable loads, Swan River Trust 2009)	34.4	3.2

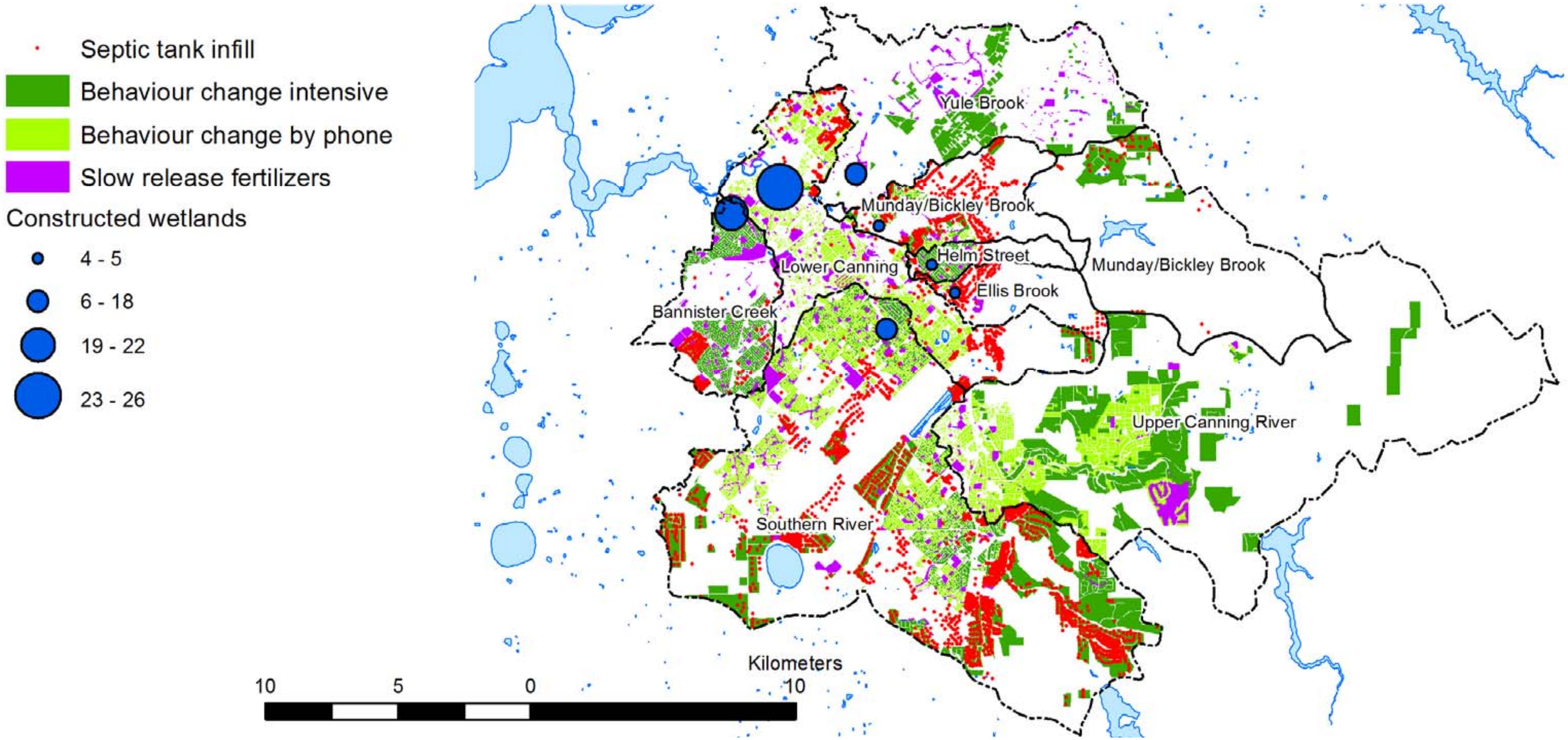
Results: Base case scenario

% of target	N export, ton/year	P export, ton/year	Infill of septic tanks, number	Constructed wetlands, ha	Imported fill on residential developments, ha	Behaviour change intensive, ha/year	Behaviour change by phone, ha/year	Ban regular fertilisers, ha/year	Fertiliser action plan, ha/year	Slow release fertilisers on POS, ha/year	Phos Lock, ton/year	Capital cost, $M	Annual cost, $M/year	Present value of cost, $M
20%	53.3	4.0	1,089	94.7	0	566	169	No	0	1,240	0	197.4	2.1	19.7
40%	48.6	3.6	4,166	94.7	0	697	345	No	0	1,652	0	335.1	2.9	163.4
60%	43.9	3.3	10,689	94.7	8	1,135	29	No	0	1,711	0	609.3	5.0	448.9
80%	42.5	3.1	12,097	94.7	1,787	1,212	59	No	0	1,711	0	736.9	5.0	616.3
100%	42.5	3.1	12,097	94.7	1,787	1,212	59	No	37	1,711	0	736.9	5.0	616.3

Base case scenario 20% target



Base case scenario 40% target



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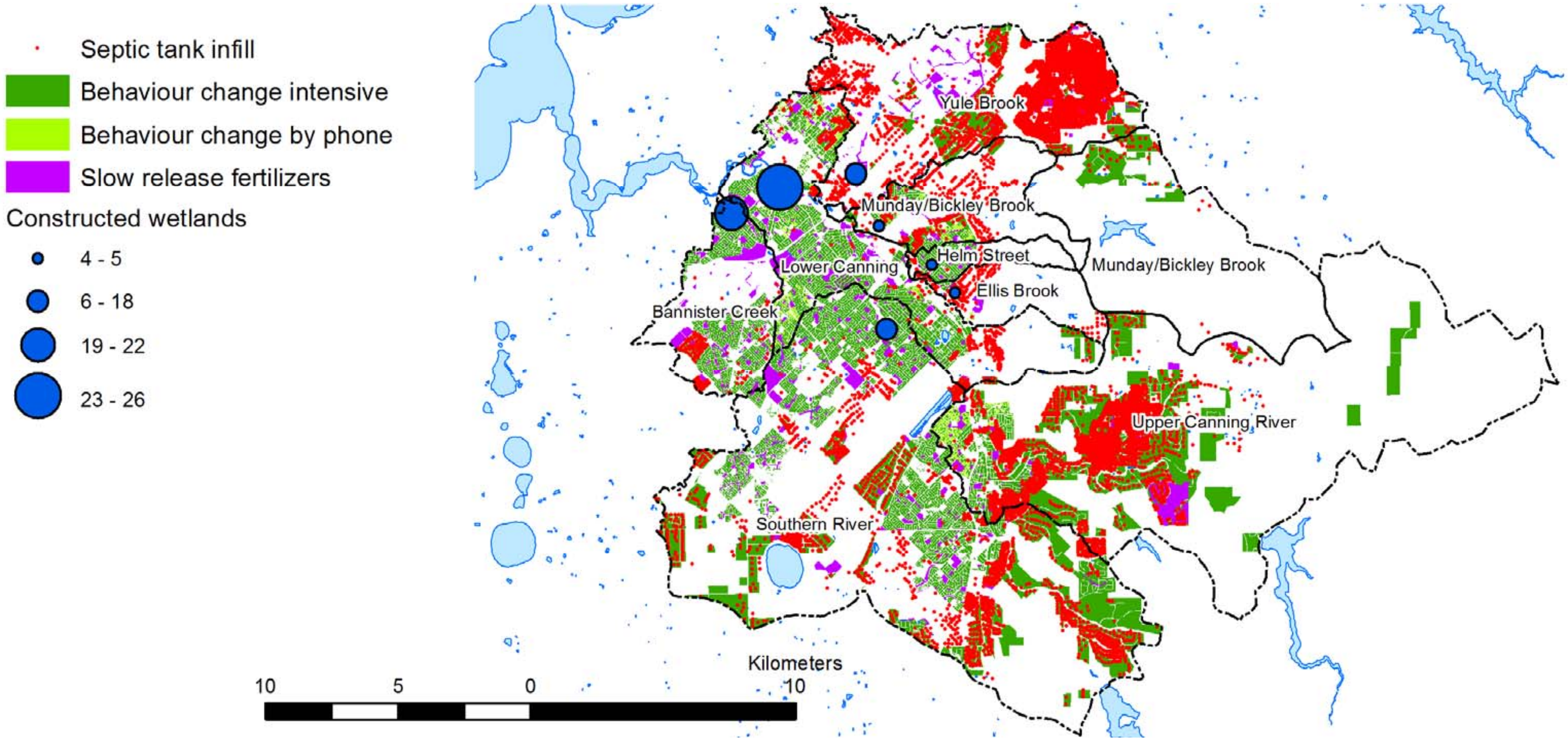
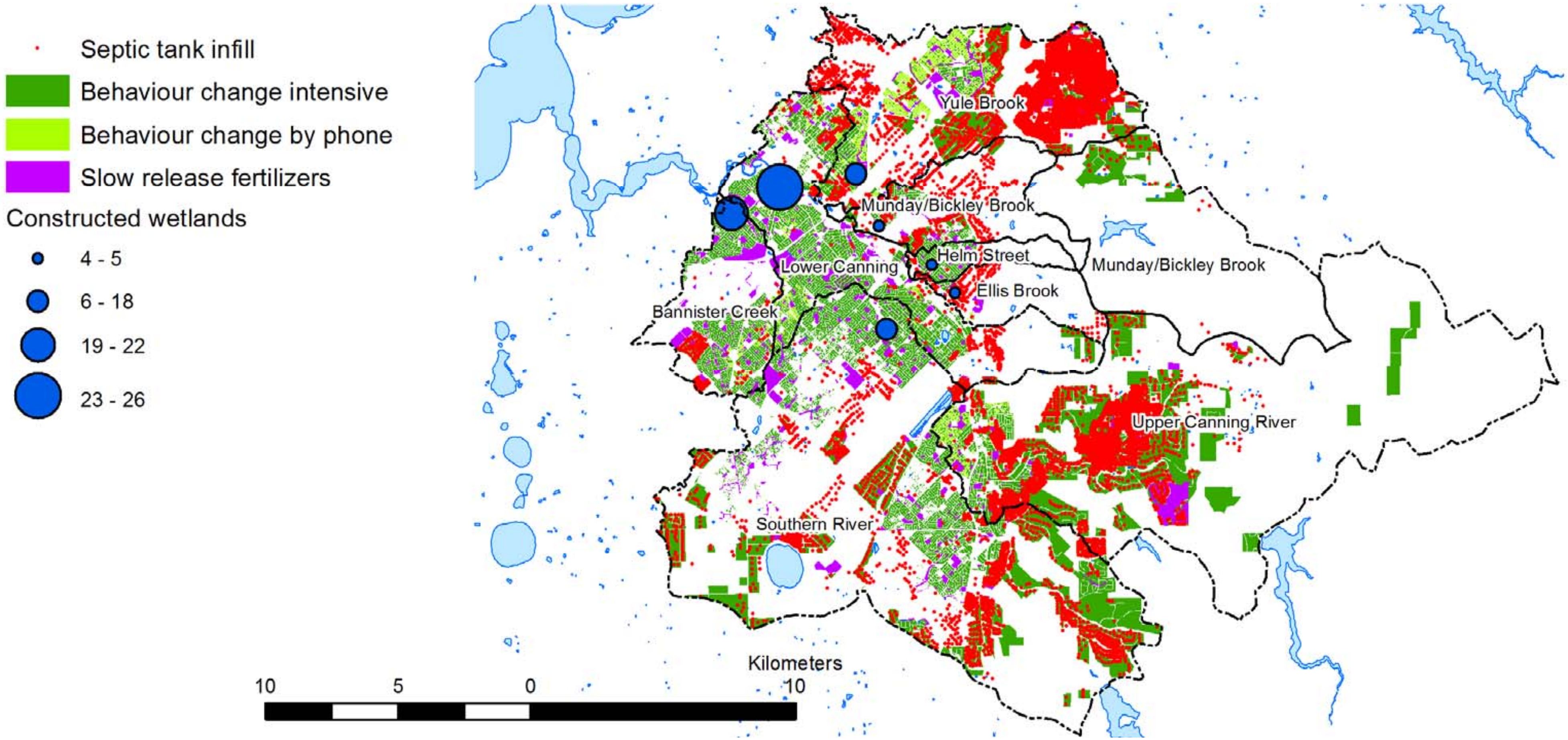
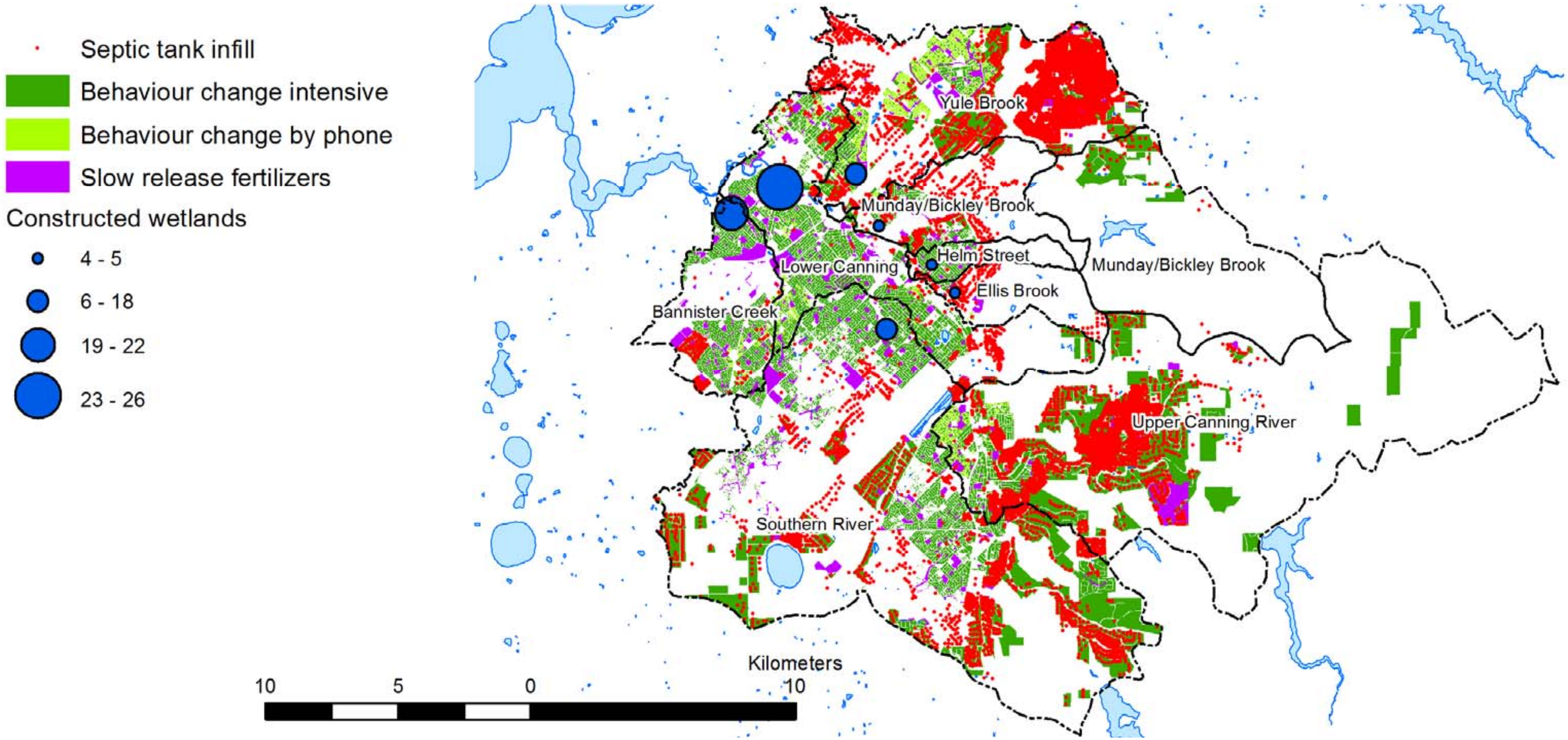
Base case scenario 60% target



Base case scenario 80% target



Base case scenario 100% target



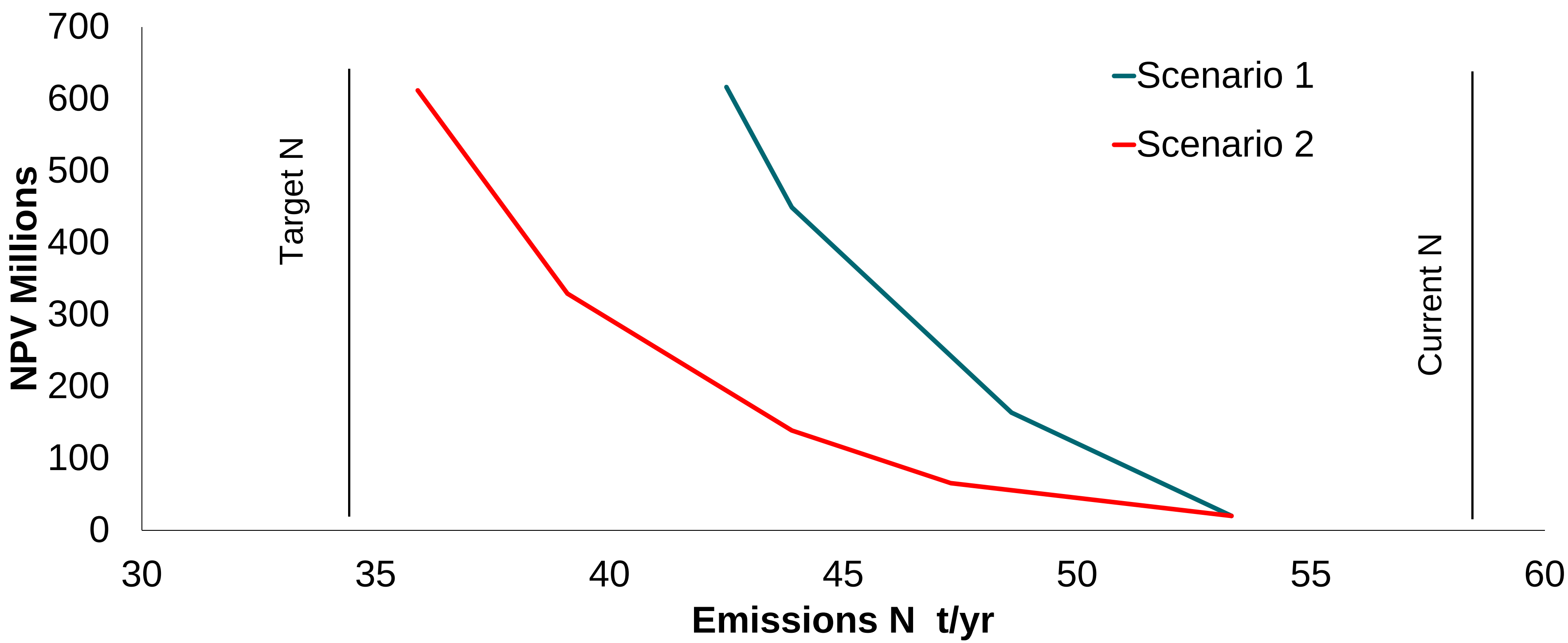
Alternative scenario: Ban regular fertilisers

% of target	N export, ton/year	P export, ton/year	Infill of septic tanks, number	Constructed wetlands, ha	Imported fill on residential developments, ha	Behaviour change intensive, ha/year	Behaviour change by phone, ha/year	Ban regular fertilisers, ha/year	Fertiliser action plan, ha/year	Slow release fertilisers on POS, ha/year	Phos Lock, ton/year	Capital cost, $M	Annual cost, $M/year	Present value of cost, $M
20%	53.3	4.0	1,089	94.7	0	566	169	No	0	1,240	0	197.4	2.1	19.7
40%	47.3	3.9	0	94.7	0	0	0	Yes	0	0	23.8	158.5	5.7	65.3
60%	43.9	3.7	1,928	94.7	0	0	0	Yes	0	0	17.2	239.3	5.7	138.7
80%	39.1	3.4	7,315	94.7	3	0	0	Yes	0	0	9.6	436.9	5.7	329.2
100%	35.9	3.2	12,097	94.7	1,787	0	0	Yes	0	0	10.1	736.9	5.7	611.5

Comparison of scenarios

Target N (t/y)	Target P (t/y)	Achieved N (t/y)	Achieved P (t/y)	10 y capital cost $M	Average annual cost $M	Present value of cost $M
Current emission						
		58.1	4.5			
Base case						
34.4	3.2	42.5	3.1	736.9	5.0	616.3
Banning regular fertilisers						
34.4	3.2	35.9	3.1	736.9	5.7	611.5

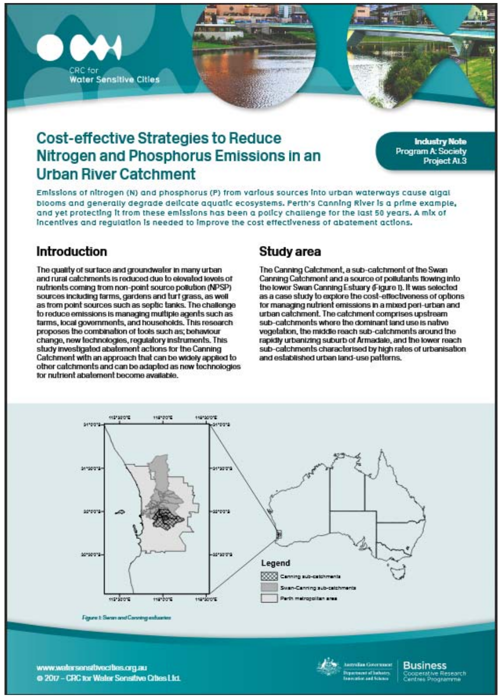
Cost of abatement at various nitrogen emissions targets



Conclusions

- At low levels of abatement, septic tank infill, constructed wetlands and slow release fertilizer provide least cost abatement actions
- The priority areas are Bannister Creek and Southern River catchments.
- The cost of achieving a 60% of reduction target of N and P is $449M, which is similar to a conservative estimate of the nonmarket value of water quality improvement in the Canning is $22M/y (discounted in perpetuity at 5% this give a value of $440M).
- When we include option of banning regular fertilisers, it is possible to achieve close to target loads for N at a cost of $612M

More information



Cost-effective Strategies to Reduce Nitrogen and Phosphorus Emissions in an Urban River Catchment

Industry Note
Program A: Society
Project A1.3

Emissions of nitrogen (N) and phosphorus (P) from various sources into urban waterways cause algal blooms and generally degrade delicate aquatic ecosystems. Perth's Canning River is a prime example, and yet protecting it from these emissions has been a policy challenge for the last 50 years. A mix of incentives and regulation is needed to improve the cost effectiveness of abatement actions.

Introduction

The quality of surface and groundwater in many urban and rural catchments is reduced due to elevated levels of nutrients coming from non-point source pollution (NPSP) sources including farms, gardens and turf grass, as well as from point sources such as septic tanks. The challenge to reduce emissions is managing multiple agents such as farms, local governments, and households. This research proposes the combination of tools such as; behaviour change, new technologies, regulatory instruments. This study investigated abatement actions for the Canning Catchment with an approach that can be widely applied to other catchments and can be adapted as new technologies for nutrient abatement become available.

Study area

The Canning Catchment, a sub-catchment of the Swan Canning Catchment and a source of pollutants flowing into the lower Swan Canning Estuary (Figure 1). It was selected as a case study to explore the cost-effectiveness of options for managing nutrient emissions in a mixed peri-urban and urban catchment. The catchment comprises upstream sub-catchments where the dominant land use is native vegetation, the middle reach sub-catchments around the rapidly urbanizing suburb of Armadale, and the lower reach sub-catchments characterised by high rates of urbanisation and established urban land-use patterns.

- https://watersensitivecities.org.au/content/cost-effective-strategies-reduce-nitrogen-phosphorus-emissions-urban-river-catchment/

- https://watersensitivecities.org.au/content/cost-effective-strategies-reduce-nitrogen-phosphorus-emissions-urban-river-catchment-2/